

Theoretical challenges from Initial observations from the three meter diameter geodynamo experiment

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A liquid sodium model of the earth's outer core has been fabricated to be able to reach a magnetic Reynold number of  $Rm=900$ .

The first two years of experiments were done using water as a working fluid and observed precessionally driven flows and turbulent bi-stability in spherical

shear flow. Afterward, the initial sodium metal flows are in hand with a few months of

trial runs. We have seen significant induction of magnetic fields by the Omega effect and many other induced magnetic field effects. While no dynamo effect has been observed at half speed ( $Rm<450$ ) we have seen a gain of seven in the Omega effect, but not yet enough conversion of toroidal to poloidal field to self-generate. We have also characterized the power input of the system as a function of Rossby number, observed a dozen different non-dynamo states, and examined the fluctuations in induced magnetic field. For now all of this is at parameters not yet accessible by simulation, but the observations are likely amenable to theory in reduced models.